

PEABODY CONTINUOUS COKING PROCESS

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ABSTRACT

The paper presents a description of the Peabody Continuous Coking Process which produces coke from coal in a continuous operation. Carbonization is initiated on a moving bed grate carbonizer. A controlled flow of preheated air at 450° F is percolated through the moving bed. Retention time in this pre-treatment furnace is normally about 18 minutes. The product from the moving bed containing 7-10% volatile matter is discharged to a shaft furnace where devolatilization is completed. The hot coke product from the shaft furnace is cooled with inert gas which is generated in the process. By-product gas from the moving bed carbonizer and shaft furnace are combined and used as energy for steam generation or for other purposes. Utilization of the by-product energy is essential to the economics of the process.

INTRODUCTION

The original development work on carbonization of coal on a moving bed furnace was done by Mr. A. H. Andersen of Shawinigan Chemicals, Ltd. at Shawinigan Falls, Quebec in the late 1930's. During the pre-war period, Shawinigan put into operation a number of moving bed carbonizers to produce coke for use in carbide furnaces.

Study of this original work and test reports on a similar installation in South Africa in the middle 1950's indicated certain limitations as to the size of

coal that could be carbonized on a moving bed carbonizer without excessive burning of fixed carbon at the expense of coke yield.

In 1957 Peabody Coal initiated the research and development that resulted in combining a moving bed carbonizer with a shaft furnace. Early test work indicated that to make a totally enclosed continuous system, inert gas cooling or quenching of the product was required to prevent air pollution.

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1. Andersen, A. H. and N. R. Fasken
Carbonization. U. S. Pat. 2,380,930
August 7, 1945
Andersen, A. H. and J. E. Renaud
Coke Production. U. S. Pat. 2,209,255
July 23, 1940
 2. LaGrange, C. C. Journal of the South African Inst. of Mining
& Metallurgy
October, 1956 v 57 No. 3 pp 99-114

DESCRIPTION OF PROCESS

Figure I shows a flow sheet of the continuous coking process. Coal is fed uniformly by a layer loader onto a moving bed grate carbonizer where the coal is subjected to a furnace environment of 1800°F to 2000°F . Ignition of the coal is automatic as it enters the furnace on the top layer of the coal bed. Carbonization through the plastic state proceeds downward as a controlled amount of preheated air (450°F) is percolated upward through the moving bed. Retention time in this pretreatment furnace is normally 18 minutes and timed to prevent over-carbonization of the top layer of coal.

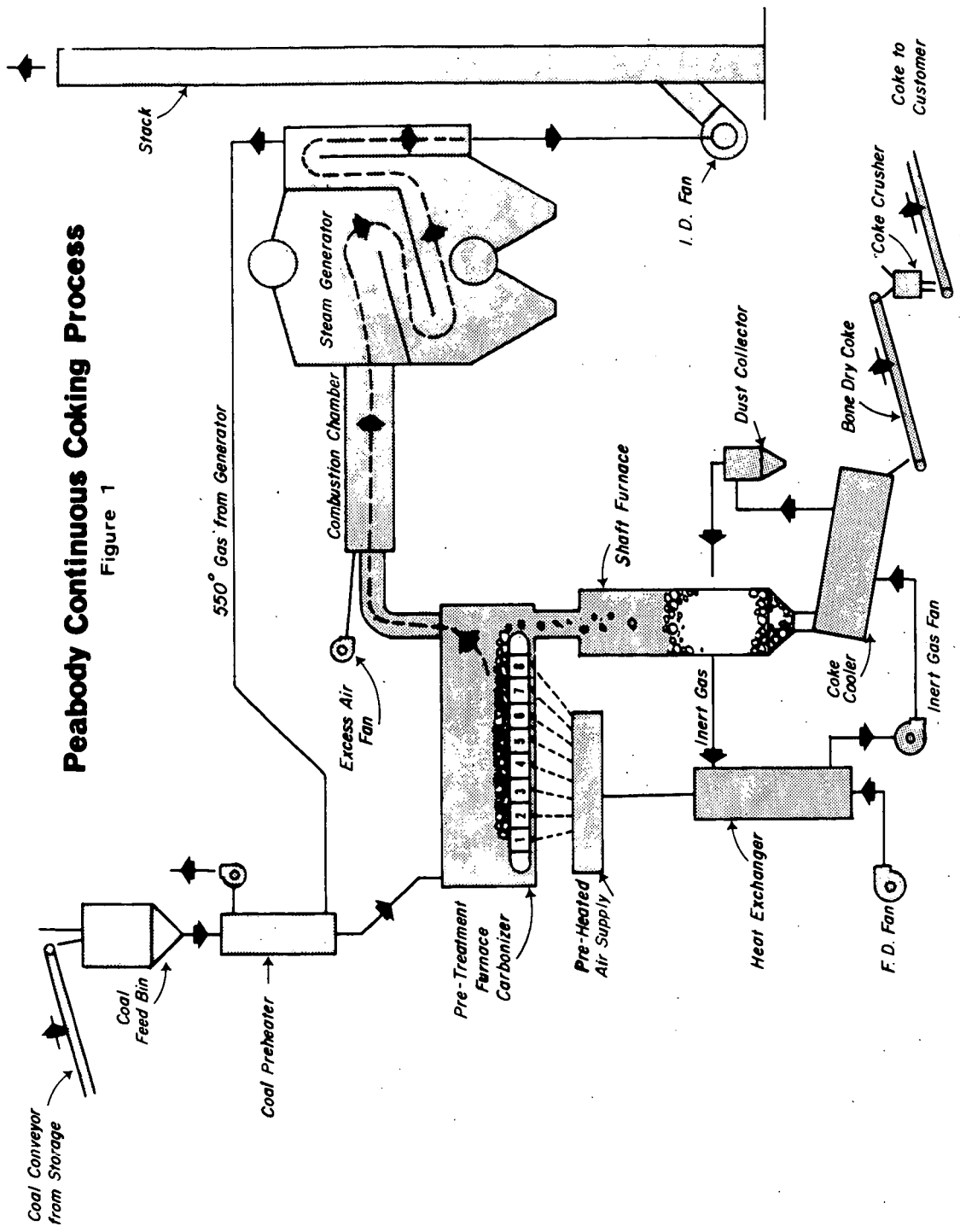
To prevent excessive carbonization of the top layers, the timing and the amount of preheated air is controlled so that 7% to 10% volatile still remains in the product as it is discharged into the shaft furnace. Devolatilization is completed in the shaft furnace without air by retention of the product in the shaft furnace for one hour.

At the bottom end of the shaft furnace the hot coke product (1600°F to 1800°F) is discharged by gravity into an inert gas cooling unit where the coke product is cooled to a temperature of 250°F . The inert gas is self-generated in the combined shaft furnace and cooling system. This system is totally enclosed and prevents air pollution from dust particles or gases.

The by-product gas generated in the moving bed carbonizer and the shaft furnace are combined as an energy supply for steam generation or for other heat-using processes. The use of the by-product gas (approximately equivalent to CO gas) is essential to the economics of the process, particularly with high volatile coals.

Peabody Continuous Coking Process

Figure 1



TYPICAL ANALYSIS OF PRODUCTFORELECTRIC FURNACES

| | <u>Coal Input</u> | <u>Coke Output</u> |
|----------------|--------------------------|--------------------------|
| | <u>Chemical Analysis</u> | <u>Chemical Analysis</u> |
| % Fixed Carbon | 54.59 | 89.52 |
| % Ash | 4.33 | 8.76 |
| % Volatile | 37.71 | 1.72 |
| % Moisture | 3.37 | .00 |
| % B. T. U. | 13,965 | 13,035 |
| % Sulfur | 1.03 | .90 |

| <u>Size</u> | <u>Screen Analysis</u> | <u>Screen Analysis</u> |
|-------------|------------------------|------------------------|
| | <u>Percent</u> | <u>Percent</u> |
| 1 X 1-1/2 | 6.9 | 3.9 |
| 5/8 X 1 | 21.5 | 11.7 |
| 1/2 X 5/8 | 14.2 | 23.6 |
| 1/4 X 1/2 | 32.0 | 53.3 |
| -1/4 | 25.4 | 7.5 |

ENERGY BALANCE OF PEABODY PROCESS

| | <u>Input</u> | <u>Output</u> | |
|------------------------------------|--------------|---------------|-------|
| | M - B. T. U. | M - B. T. U. | |
| Energy in Coal | 27.92 | | |
| Energy Reporting into Coke | | 15.50 | |
| Energy Reporting into Steam | | <u>10.44</u> | |
| Total Energy Recovered in Products | | 25.94 | |
| Energy Conversion Efficiency | | | 92.9% |

ECONOMICS OF THE PEABODY COKING PROCESS

Figure 2 was prepared from extensive tests and operating data obtained at the Columbia, Tennessee plant, which has been in continuous production for the past eight years. Capital cost data was based upon a 500-ton per day coke plant and the return on investment was calculated at 16% before taxes.

FLEXIBILITY OF THE PROCESS

1. The process variables of temperature, speed of carbonization, air to coal ratio, retention time, can be controlled over such a wide range of environment that practically all classes of coal can be carbonized.
2. The process can produce a bone dry coke product with a density range from 9 pounds per cubic foot to 32 pounds per cubic foot.
3. A blend of coals is not required to produce a suitable coke.
4. The continuous coking system is totally enclosed and can operate without dust or without objectionable air pollution.

Process Economics

Figure 2

